Efficient Recursive Image Enhancement with Gamma Corrections and White Balancing

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Abstract - Image are having better contrast ratio appear better in visuals domain. To make contrast ratio better it needs to be enhanced with the help of mapping of different levels of pixel intensities. The enhancements in image must not lose the information which is quite challenging task some of them are probabilities of variation in the pixel structure and intensity level varies with the change in the objects of the images. To achieve this various methodologies has been proposed. In this work we are working on the repetitive or recursive approach for enhancements which significantly modify the pixel values for management of contrast levels along with gamma values corrections and white balancing. This overall algorithm make image more informative or enhanced than the corrupted version. In general images are the integrated part of human lives and all are capturing and storing to save special moments and memories for future. The capturing of images and its quality are depends on the environmental factors which is not in our control so images get corrupted due to low light, reflections, fog or moistures etc. The experimental results show the effectiveness of the algorithm. For calculation of effectiveness of proposed algorithm we have compared PSNR with existing work and found better.

Keywords - Sequential Approach, Recursive Colour Adjustment, Light Reduction, PSNR, Entropy.

I. INTRODUCTION

Contrast is the difference in visual properties that makes an object (or its representation in an image) distinguishable from other objects and the background. In visual perception of the real world, contrast is determined by the difference in the color and brightness of the object and other objects within the same field of view. In other words, it is the different between the darker and the lighter pixel of the image, if it is big the image will have high contrast and in the other case the image will have low contrast.

Generally, in some images contrast is very low; due to the contrast variations the quality of the image is also low so utilizing Image enhancement techniques to enhance the contrast of an image. Image Enhancement is a technique to improve the quality of a digital image. By using the image Enhancement technique, there are some similar operations like removing noise in the image, sharpening the image, brighten an image, Increasing or decreasing the contrast of the image are performed.

Contrast enhancement [1] is a method which adjusts the image histogram to redistribute the pixels between the highest and darkest portions of the image. Especially contrast enhancement stretches or contrast the range of intensities in an image, depending upon the desires effect. Contrast enhancement [2] is the most used technique in image enhancement. In image enhancement it can observe that there are many side effects while undergoing the process. When there is a low contrast in an image, then images are enhanced.

Digital Image Processing usually refers to the processing of a 2-dimensional (2-D) picture signal by a digital hardware. The 2-D image signal might be a photographic image, text image, graphic image (including synthetic image), biomedical image (X-ray, ultrasound, etc.), satellite image, etc.

An image is a 2-D function (signal), f(x,y), where x and y are the spatial (plane) coordinates. The magnitude of f at any pair of coordinates (x,y) is the intensity or gray level of the image at that point. In a digital image, x,y, and the magnitude of f are all finite and discrete quantities. Each element of this matrix (2-D array) is called a picture element or pixel. Image processing refers to some algorithms for processing a 2-D image signal, i.e. to operate on the pixels directly (spatial- domain processing) or indirectly (transform-domain processing). Such a processing may yield another image or some attributes of the input image at the output.

It is a hard task to distinguish between the domains of image processing and any other related areas such as computer vision. Though, essentially not correct, image processing may be defined as a process where both input and output are images. At the high level of processing and after some preliminary processing, it is very common to perform some analysis, judgment or decision making or perform some mechanical operation (robot motion).

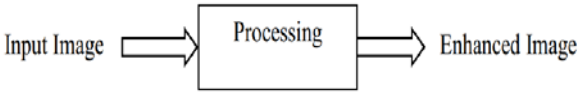

Figure 1.1 Basic Illustration of Image Enhancement.

Image Enhancement is used for Image Smoothing, Image Sharpening or Crispening, Contrast Stretching and Pseudo coloring.

II. CONTRAST ENHANCEMENT

The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. The word specific is important, because it establishes at the outset that the techniques are oriented to the problem. Thus, for example, a method that is quite useful for enhancing X-ray images may not necessarily be the best approach for enhancing pictures of Mars transmitted by a space probe. Regardless of the method used, however, image enhancement is one of the most interesting and visually appealing areas of image processing. Image enhancement approaches fall into two broad categories: spatial domain methods and frequency domain methods. The term spatial domain refers to the image plane itself, and approaches in this category are based on direct manipulation of pixels in an image. Frequency domain processing techniques are based on modifying the Fourier transform of an image. Enhancement techniques based on various combinations of methods from these two categories are not unusual. There is no general theory of image enhancement. When an image is processed for visual interpretation, the viewer is the ultimate judge of how well a particular method works. Visual evaluation of image quality is a highly subjective process, thus making the definition of a "good image" an elusive standard by which to compare algorithm performance. When the problem is one of processing images for machine perception, the evaluation task is somewhat easier. For example, in dealing with a character recognition application, and leaving aside other issues such as computational requirements, the best image processing method would be the one yielding the best machine recognition results. However, even in situations when a clear-cut criterion of performance can be imposed on the problem, a certain amount of trial and error usually is required before a particular image enhancement approach is selected.

a. Gamma Correction

Generally, if an image is project on computer screen, some images which are not corrected can be look either too bright or too dark. So there is a need to correct the image, gamma correction is utilized to control the brightness and color ratios of an image.

b. Display Gamma

From the figure 2.1 the shortest line between two points represents the linear light which limits between 0 to 1.

For the best picture quality, dynamic range should not reach 0 or 1. For these limit, there are infinite curves possible. The shape of the curve depends on the shadows and highlights visible to human eye.

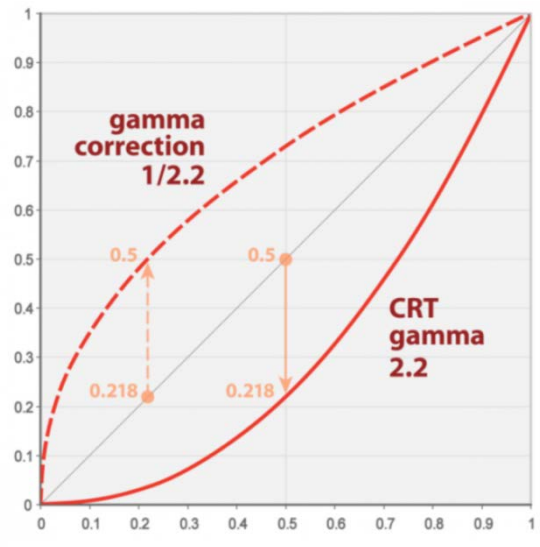

Figure 2.1 Gamma Curve.

These curves are a nonlinear form so it is treated as a logarithmic equation. Gamma always looks nonlinear also does not have a constant to curve.

RGB is normalized by using gamma operation. This value is determined by identity from the linear RGB values.

As the gamma value increase the curve in the graph pulls down that means the image draws into the dark regions (mapping more values into darker region) so the image goes darker.

As decrees the decreasing the gamma value, the curve in the graph pushes in the upside direction that means the image draws into the lighter region (mapping more values into lighter region) so the image goes lighter.

III. PROPOSED METHODOLOGY

The proposed algorithm efficient recursive image enhancement with gamma corrections and white balancing has been implemented and simulated on MATLAB.

The block representation of design and process flow has been given in figure 3.1 and figure 3.2 respectively.

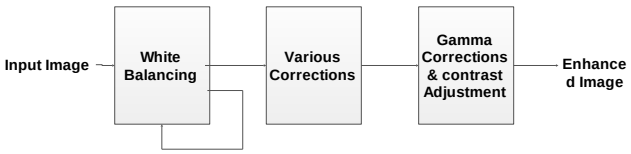

Figure 3.1 Block Representation of proposed algorithm.

Based upon analysis algorithm is established for image enhancement by consuming MATLAB. Results accomplished after the implementation of program are equated with the previous outputs.

In proposed algorithm a recursive gamma correction and white balancing is applied on sample image until the contrast of test image enhanced.

There are mainly three blocks in proposed algorithm which are-

(1) White Balancing

A recursive white balancing technique has been applied on input image to achieve effective white balancing as illustrated in figure 3.1.

(2) Various Corrections

Various corrections like photometric transformation and environmental reflection correction as well as white balancing has been applied on processing image.

(3) Gamma Corrections and Contrast Adjustment.

After various corrections Gamma correction has been applied on processes image followed by contrast adjustment.

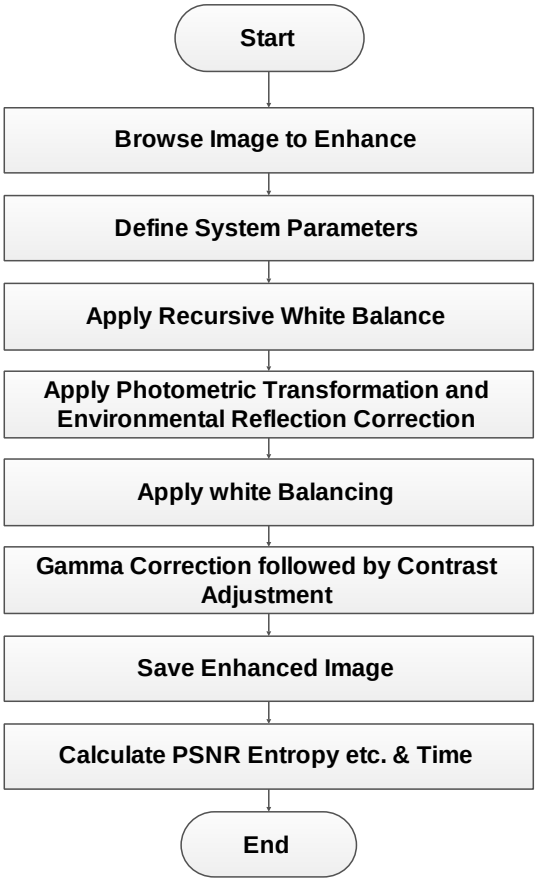

Figure 3.2 Process flow of proposed algorithm.

Process flow of proposed work has been given in figure 3.2. The steps of process flow are as follows.

1. Start simulation with MATLAB

2. Browse test image to enhance

3. Define system parameters

4. Apply recursive white balancing

5. Apply photometric transformation and environment reflection correction

6. Apply white balancing

7. Gamma correction followed by contrast adjustment

8. Save enhanced image

9. Calculate PSNR entropy etc and time.

10. End process

IV. EXPERIMENTAL RESULTS

The Simulation of proposed algorithm has been done on MATLAB simulation environment Simulink for the corrupted image as shown in figure 4.1 (a) Brain Slices (b) Street View (c) Cars Model (d) Road Map (e) Magazine Cover. The corresponding corrected enhanced image has given at right hand side of corrupted image.

The Simulation outcome shows that the proposed algorithm outperforms as compared to existing algorithm in terms of visual as well as following parameters PSNR and entropy. The comparison of PSNR of proposed algorithm with existing algorithm has been shown in table 1 and entropy comparison of proposed algorithm with existing algorithm has been shown in table 2. Fig. 4.2 shows the graphical representation of comparison of PSNR with Existing Work and Fig. 4.3 shows graphical representation of comparison of Entropy with Existing Work.

Table 1: Comparison of PSNR with Existing Work

Image	Existing (Base Paper) Work	Proposed(Our) Work
Brain Slices	85.21 dB	92.34 dB
Street view	91.29 dB	83.01 dB
Cars model	75.55 dB	83.08 dB
Road map	75.93 dB	89.71 dB
Magazine cover	85.11 dB	86.41 dB

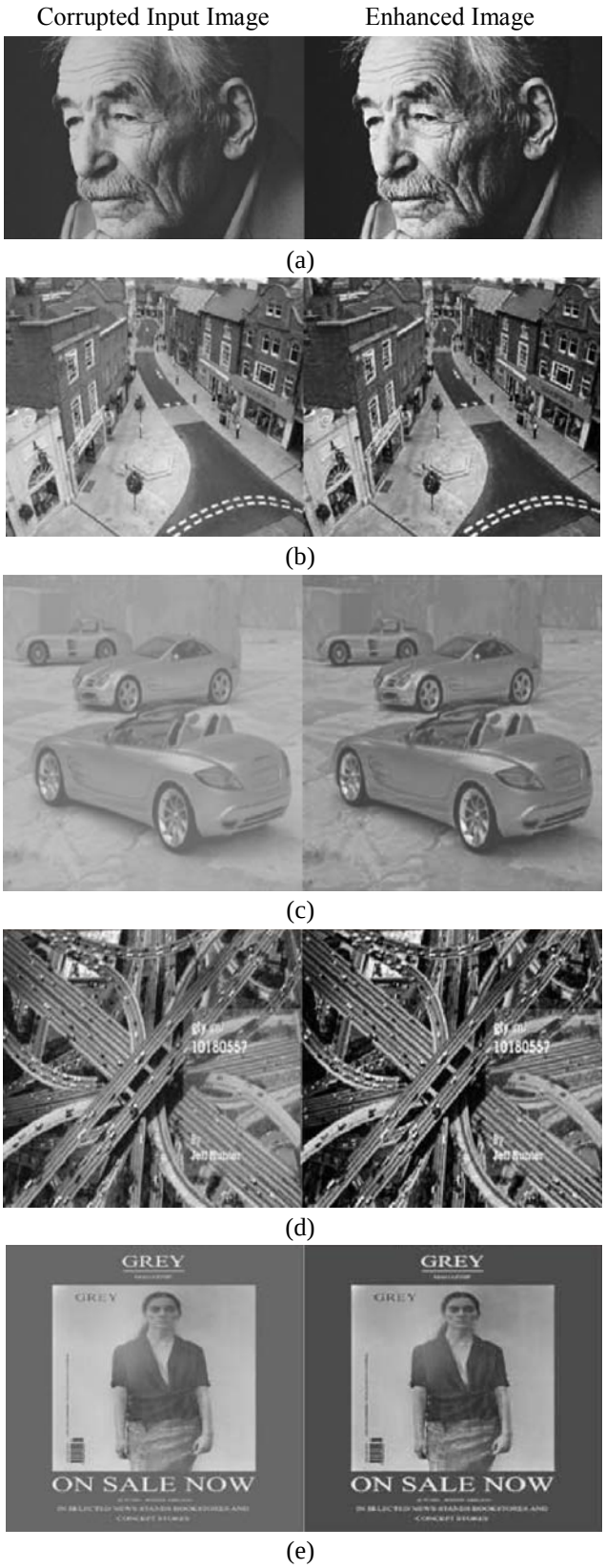

Fig. 4.1 Input Image and Enhanced Image of (a) Brain Slices, (b) Street View, (c) Cars Model, (d) Road Map, (e) Magazine Cover.

It is clearly visible from simulation of proposed work in Matlab Simulink that proposed algorithm has batter proficiency of image enhancement as compared to existing algorithm from table 1 and table 2 based on PSNR value and entropy.

Table 2: Comparison of Entropy with Existing Work

Image	Existing (Base Paper) Work	Proposed(Our) Work
Brain Slices	0.9757	0.0669
Street view	0.1413	0.0758
Cars model	0.3451	0.0656
Road map	0.5004	0.0772
Magazine cover	0.0636	0.0545

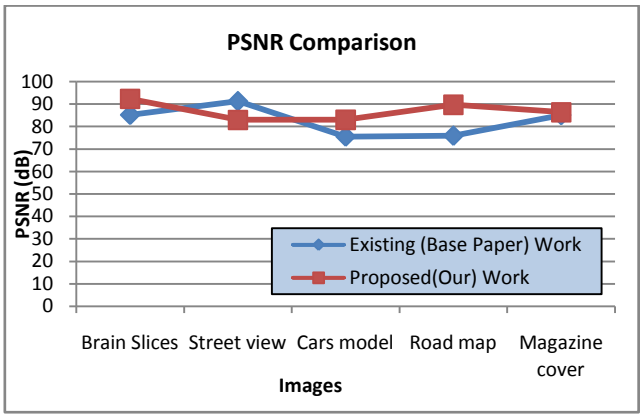

Fig. 4.2 Chart comparison of PSNR with Existing Work

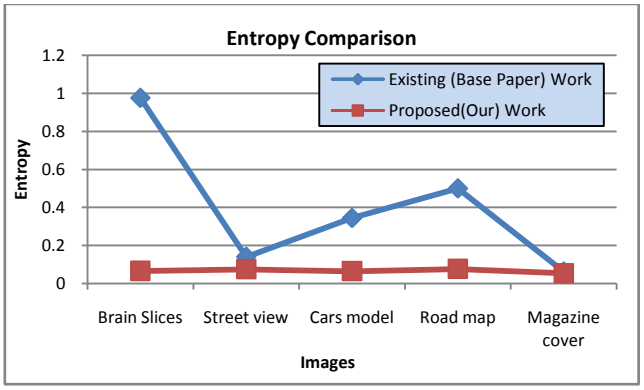

Fig. 4.3 Chart comparison of Entropy with Existing Work

V. CONCLUSION AND FUTURE SCOPES

The fundamental objective of this research is on image enhancement using image enhancement techniques. The implementation and simulation of proposed recursive image enhancement with gamma corrections and white balancing algorithm is done on MATLAB SIMULINK. The performance of the proposed algorithms for image enhancement has been compared with existing algorithms. This algorithm is tested on different types of images.

A qualitative comparison between existing algorithms and proposed algorithm is done on different images Brain

Slices, Street View, Cars Model, Road Map, Magazine Cover based on PSNR and entropy. The Simulation result shows that the brightness is increased as compared to previous one.

Future work can be extended for other images to obtain better result with accuracy. In future alteration of the algorithm can yield the improved result for the image. The improved result for image enhancement has also used in real time enhancement. Image enhancement methods used in numerous areas such as Fingerprint matching, Forensics and Astrophotography etc.

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